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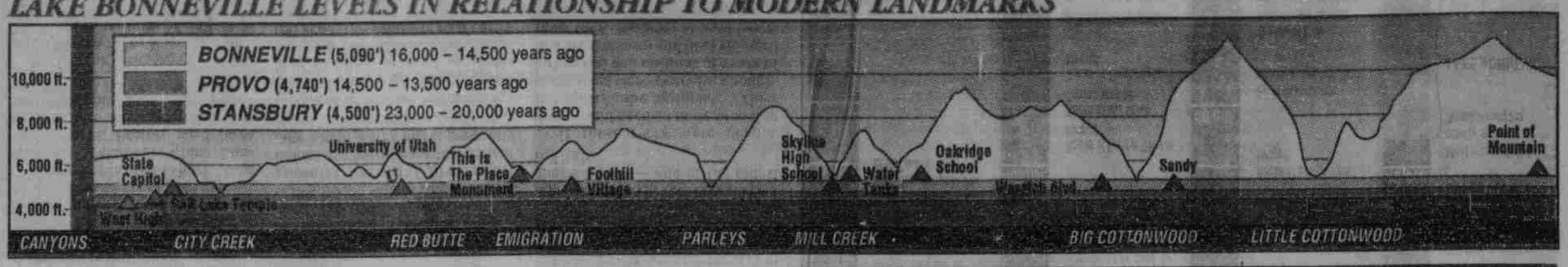


Great Salt Lake Geology Reveals Earth's Secrets

By Tom Wharton
THE SALT LAKE TRIBUNE

Great Salt Lake geology is a study in contrasts.

Along the shores of Antelope Island, for example, one can find rocks kicked out of volcanoes three billion years ago — and gravel formed in the 1980s when the lake reached its highest level this century.

The Great Basin — which stretches from the Sierra Nevada to the Wasatch Range — is widening a half-inch each year. Yet an earthquake caused by the stretching could cause parts of the Salt Lake Valley to drop several feet in an instant.

Great Salt Lake is shallow, but ancient Lake Bonneville was 1,000 feet deep. If the present lake level rises a few inches, the shoreline expands several feet.

The high, snow-capped mountains between the Sierra Nevada and the Wasatch Front offer lush, alpine vegetation. Yet the largest natural lake in North America sits in one of the continent's great deserts.

"Its rainfall is negligible and its scenery depressing to all but the few who have lived in it long enough to acquire a new set of values about scenery," author Wallace Stegner writes in his book *Mormon Country*. "Its climate shows extremes of temperature that would tire out anything but a very strong thermometer. It is a dead land, though a very rich one."

Adds author Stephen Trimble in his book *The Sagebrush Ocean*: "Basin is a better word than valley for these between-mountain lowlands. The word valley brings to mind a gentle green pathway to the sea. What few river valleys exist here always lead to a closed basin with a central sump, a dead heart."

The dead heart of the Western basin is the Great Salt Lake, a remnant of ancient Lake Bonneville which once covered portions of Utah, Nevada and Idaho. Delta and Wendover would have been under 1,000 feet of water. Much of Salt Lake City, Ogden and Provo also would have been covered with water.

As the lake began receding about 14,500 years ago, it left salt flats, alkali deserts and the largest lake in the Western Hemisphere with no outlet to the sea. Lake Bonneville deposits serve as a sort of geologic tree ring that allows scientists to look into the past — enabling them to predict the future.

Geologists Genevieve Atwood and Don Mabey use Antelope Island as their laboratory, trying to piece together the puzzle of the past 10,000 years. By examining shorelines, these researchers have learned that the rising waters of the Great Salt Lake in the mid-1980s were not unprecedented. In fact, shorelines indicate that such floods occur about every 100 years.

"The National Weather Service and the news media, with understandable enthusiasm to report new records based on relatively short periods of observation, may have conveyed the impression that the cycle of wet weather is unprecedented in history," said Mabey. "This is not true."

During the last 10,000 years, the Great Salt Lake has risen above its historic 1986 high of 4,212 feet several times. It has not exceeded an elevation of about 4,221 feet.

"Our records are so short," said Atwood. "If this were China, London or even Boston, we'd have written accounts that would put the 1870s and 1980s into perspective."

As Utahns discovered in the mid-1980s, a rising lake can cause hundreds of millions of dollars in damage to public facilities. It can threaten mineral industries, railroad causeways, the Salt Lake City International Airport, interstate highways, wastewater treatment facilities, low-lying recreational and commercial developments and wildlife refuges.

"Above an elevation of 4,215, the lake under natural conditions expands west into the Great Salt Lake Desert," said Mabey. "As the surface area of the lake increases, so does the volume of water which evaporates from the lake. When the loss from evaporation equals inflow, the lake stops rising."

Lake Bonneville is the world's most studied Ice Age lake. And those who examine it and fluctuations of the Great Salt Lake learn that humans can't control the briny body of water.

"We know the lake is a closed basin and that its shoreline is going to constantly change throughout time," said University of Utah geologist Frank DeCourten. "We are no better at predicting the behavior changes of the Great Salt Lake than we are at predicting long-term climatic changes. The shoreline moves in and out. The kind of animals and plants that live around it accommodate those changes. We as people should do the same. The lake will probably never be totally manageable in the way many of our industrial and residential developers would like."

Geologists Atwood and Mabey say some development has already entered the danger zone. Some of the Rose Park area of Salt Lake City could be flooded if a major earthquake occurred when the Great Salt Lake was at its historical high. The valley floor would tilt, spilling salt water eastward.

Recognizing that the lake could flood every 100 years, they believe development near shores should be carefully planned. "We look at the lake as an interesting, but often cantankerous, neighbor," said Atwood.

Old Lake Bonneville is still with us. Shorelines created by the ancient lake are easily seen from the valley floor — like a ring around a gigantic bathtub. Almost all homes are built below the ancient lake's high-water mark, generally about 5,200 feet in elevation.

"Tilted shorelines tell us things about the innards of the earth and how mobile the crust is," said Atwood. "Displaced shorelines tell about the timing of past earthquakes."

Environmentalist Rick Reese believes all Utahns should have access to those secrets. He envisions a "shoreline trail" for hikers, joggers and bicyclists stretching from Ogden to Provo. Reese is now working with Salt Lake City planners on a stretch of trail from This Is the Place Monument to Parleys Canyon.

"The Bonneville bench makes an ideal site for a community trail system because it puts people high enough to enjoy a wonderful view of the valley," said Reese. "It is also high enough that, in some areas, it is above development."

Four of the state's universities — Utah, Brigham Young, Weber State and Utah State — are built on the flat surfaces left by the river deltas of Lake Bonneville, which began its demise about 14,500 years ago.

A natural dam in southeastern Idaho failed. That caused 35 million cubic feet of water per second to be released from Lake Bonneville into Idaho's Snake River. During a four- to six-week period, the amount of water pouring into the world's seas nearly doubled.

It's unlikely that the Great Salt Lake will rise again to the highest level of Lake Bonneville, Mabey said.

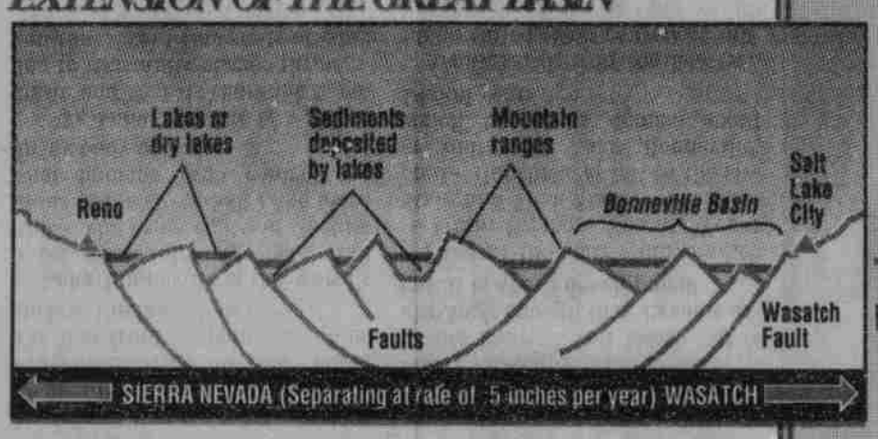
"Red Rock Pass (near Preston, Idaho) permanently lowered the rim of the Great Basin," he said. "The maximum level of a future lake is 350 feet lower than the maximum level of Lake Bonneville. The effects of human activity on the world climate cannot be predicted, but sometime in the distant future, the climate in the basin of the Great Salt Lake will likely become cooler and wetter. Then, the lake will rise to much higher levels than at any time in the last 10,000 years and flood large areas of the Wasatch Front."

But that rise will occur slowly — taking tens of thousands of years.

That gives scientists from around the world time to study the geologic contrasts. Standing on a "young" beach of gravel at Antelope Island, Atwood examines a gnarled rock — one of the oldest in Utah.

"If these rocks were people, they would need an understanding therapist," she quipped. "Their early lives were peaceful enough, but burial and millions of years of intense pressure and heat changed their rock character at least twice.

"Stresses related to mountain building sheered and deformed them. Later, they were fractured. Most recently, erosion has exposed them. These rocks have lived difficult lives."



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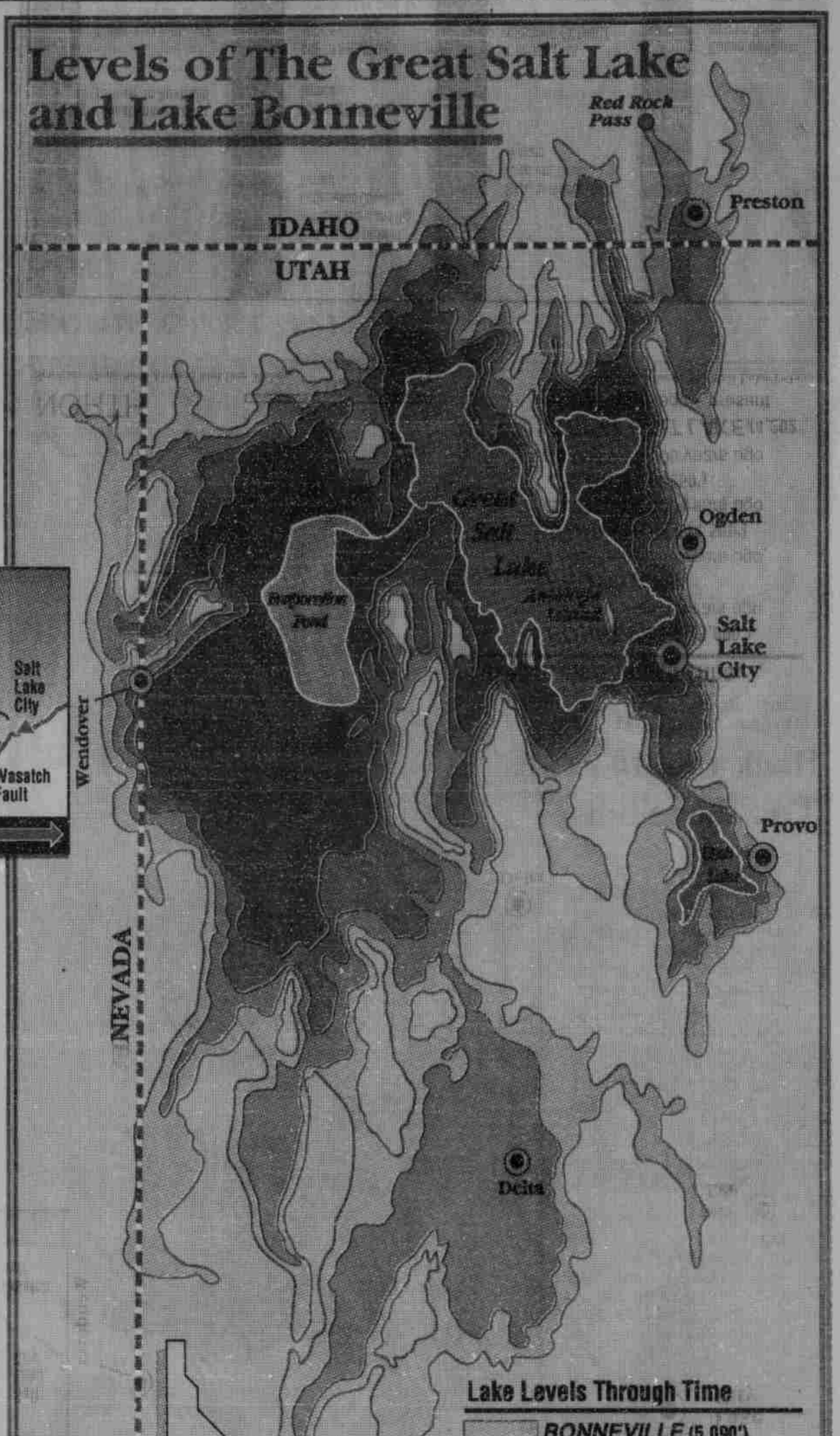

GEOLOGICAL TIMELINES

5 billion		800 million	Dark colored rocks of Antelope Island and Big Cottonwood Canyon formed	100 million	Rocks in Western Utah compress, thrust skyward	100,000	
4 billion	Oldest known rocks formed in Australia	600 million	Rocks of Neffs Canyon formed	80 million		80,000	
3 billion	Oldest rocks in Utah are formed. They can be found today on Antelope Island, and in Farmington Canyon in Davis County and the Raft River Range in Box Elder County	400 million	AGE OF PRIMITIVE FISHES Limestone now used by Geneva Steel formed	60 million	DINOSAURS BECOME EXTINCT Uinta Mountains pushed out of the earth	60,000	Glaciers develop in Wasatch Range
			Rocks of Parleys Canyon formed		Rocks of Ensign Peak formed	40,000	250 ft deep predecessor to Lake Bonneville formed. It was about three times the size of the Great Salt Lake
2 billion			Rocks of Mill Creek Canyon formed Rocks of Timpanogos formed	40 million	Explosive volcanic activity in western Utah	20,000	Most recent glacier activity occurs in Wasatch canyons LAKE BONNEVILLE
1 billion	Rocks of Mount Olympus, Twin Peaks and Big Cottonwood Canyon formed	200 million	AGE OF DINOSAURS Red rocks of Red Butte Canyon formed. These were used by pioneers for building	20 million	Granite of Little Cottonwood Canyon, Bells Canyon and Lone Peak formed. This rock was used to construct the LDS temple in Salt Lake City		ERA OF THE GREAT SALT LAKE